of short hairs on their upper sides in the male, which are wanting in the female. (The eyes are larger in the male.) The flagellum of the lower antennæ has long upward-directed setæ at the extremities of alternate joints in the female, which do not exist in the male. The first pair of gnathopoda are shorter in the male, with but few hairs near the top; they are as long as the basis of the second pair of gnathopoda in the female, slender, flexible, with long hairs on the anterior margin, and shorter curved hairs at the distal extremity. The coxæ of the second pair of gnathopoda are much higher in the female. The first two pairs of pereiopoda have the carpus and propodos fringed with long hairs at the posterior margin; these hairs are wanting in the female.

Desterro, Brazil, Oct. 10, 1864.

EXPLANATION OF PLATE X.

Fig. 1. *Batea catharinensis,* male: *b,* superior antennæ; *g,* maxilliped; *h,* first gnathopod; h^1, coxa; h^2, basis; *i,* second gnathopod; *q,* second pleopod; *r,* third ditto; *s,* fourth ditto; *t,* fifth ditto; *v,* posterior pleopod; *z,* telson.

XXXII.—*On the Fresh- and Salt-water Rhizopoda of England and India.* By H. J. Carter, F.R.S. &c.

[Continued from vol. xiii. p. 36.]

[Plate XII.]

In my last communication on the Rhizopoda of England and India, I ended with the mention of the new genus and species *Acanthocystis turfacea* (Annals, vol. xii. p. 263), the magnified view of the spine of which (vol. xiii. pl. 2. fig. 25 *i*) should not be tapering in the shaft, as therein represented, but of the same size throughout as at the bifid extremity. (See those round the entire figure.) Will the reader be pleased to make the correction?

Just preceding the mention of *Acanthocystis* allusion is made to *Actinophrys oculata* as having been in company with *A. Eichhornii* in "fresh water." This is also a mistake; for I find by my notes that this species was found in another basin, and one which contained salt water. Further, I intimated my intention to write more on *A. oculata* hereafter; so we will now return to it.

Actinophrys oculata, Stein. (Die Infus. tab. v. & Pritchard's Hist. of Infus. pl. 23.) Pl. XII. figs. 1, 2, 3.

I have only seen specimens of this species once, viz. in July

1859, and these abounded in a basin containing water from the main drain of Bombay, which is flooded by the sea at each tide. It is alike remarkable for the eye-like appearance imparted to it by the nucleus, from which its specific name has been derived, and for its gregarious habits. Stein considered that the whole of the light-coloured granular zone, with its contents, constituted the nucleus and nucleolus respectively. I am not certain that the light-coloured zone may not be outside the nucleus, when the inner circle and its contents would become the nucleus and nucleolus respectively. Both appear to consist of fine granular plasma. Stein, however, represents the whole together isolated (*l. c.*) as the nucleus of *A. oculata*, calling the light granular zone the "Marksubstanz." If the latter be within the nucleus, which I think likely, then the nucleus in this state seems to indicate a step towards generative development; but in what the rest of the process may consist, even if this be the case, remains for future observation to show.

The other peculiarity of this species, viz. its gregarious habits, allies it to *Spongilla*, which is but an aggregation of amœbous cells held together by a fine plasma. That of *A. oculata* appears to be derived from the more subtle parts of their ectosarc, since the Actinophryans thus aggregated are not in zygosis, as my figures and Stein's will show, but merely held together in the way described (figs. 1 & 2 *b b*); while stomachal cavities are extemporized in this ectosarc (*c c c*), in which fragments of nutritious matter are enclosed, apparently for the use of the whole community.

This, too, seems to strengthen the view taken that the nucleus is in a generative stage, when it may be advantageous for the *Actinophrys* to have its interior freed from all extraneous matter.

Be this as it may, there are also other cavities in the ectosarc, which contain large, smooth, subrotund, and nearly colourless masses, apparently different in nature from the fragments of crude food mentioned, being more like amylaceous concretions than the latter; but whether these have been incepted, are the remains of crude food, or what their real composition may be, I am ignorant. They also equally characterize Stein's and my own figures of this *Actinophrys* (figs. 1–3 *d d d*).

I did not observe any specimens with contracting vesicles or any other kind of vacuoles in a chain, round the Actinophryans respectively, or in the uniting sarcode, as figured by Stein; but the margins of the Actinophryans were defined by a strongly marked crenulated line, indicating a corrugated superficial layer. Nor have I in any of my sketches represented fragments of crude food *within* the Actinophryans themselves.

With *A. oculata* were associated groups of *A. Sol*, mihi (fig. 3), differing only from those of *A. oculata* in the absence of the nucleus and the strongly marked crenulated outline round the Actinophryans, with less appearance of uniting sarcode, but more of actual zygosis. Their internal contents, too, consisted almost wholly of the characteristic granular sarcode of *Actinophrys*, with complete absence of all vacuoles, even to the contracting vesicle itself—a condition most favourable for seeing the nucleus, if it had been present; but none was detected.

A complete disappearance of the nucleus (termed its "solution") and its reconstruction are not uncommon. It would seem to occur in duplicative division of the cells of *Spirogyra nitida*, &c. (A. Braun, Bot. and Phys. Memoirs, Ray Society, 1853, p. 241; and Nägeli, foot-note, p. 248); also, under similar circumstances, in the addition of new to the old tubular root-cells of *Chara verticillata* (Annals, vol. xix. p. 13); and latterly its disappearance has been demonstrated and explained in some of the freshwater Rhizopoda themselves, as in all probability connected with impregnative generation (Annals, vol. xix. p. 13).

Hence this form of *Actinophrys* may represent a stage in the generative development of *A. oculata*. But, whether or not, it was abundantly present with *A. oculata*, and will be seen by the figure to be so like it in grouping that I think it may reasonably be assumed to be only another form of this species. Indeed, according to Claparède and Lachmann (Etudes sur les Rhizopodes, p. 45, &c.), these distinguished authors could never see the nucleus in *A. Sol* with certainty, and they add,—"Stein's *A. oculata* is a marine form; but we have observed in the North Sea myriads of an *Actinophrys* that we did not know how to distinguish clearly from *A. Sol* of the fresh water, and which coincides altogether with the figure given by Stein of his *A. oculata*." It is not quite evident here how *A. Sol* can "coincide" altogether with Stein's *A. oculata*, if a nucleus could not be seen in the former. But the authors' meaning is plain, viz. that they thought *A. Sol* of the North Sea and *A. oculata* to belong to the same species, which harmonizes with what I have just stated respecting this question, and what my figures illustrate.

In the representations which I have given of *A. oculata*, fig. 1 is shaded, while fig. 2 is only an outline of nine individuals in aggregation, with two vacuoles containing each the remains of a rotatory animalcule, and the other the apparently amylaceous body to which I have alluded. In fig. 1 all the tentacles bore drop-like masses of ectosarc along their shafts respectively; but these have only been inserted in those of the Actinophryan *a*, for the purpose of lessening the trouble of engraving and to avoid confusion in the plate. In the group, fig. 3, the tentacles were smooth, and bore no superfluous portions of sarcode; but it will presently be seen, as it has already been shown in the Actinophryans figured in my last plate (*l. c.*), and as it will be seen in others in the one illustrating this paper, that the presence of these additional portions of ectosarc (which may assume various forms and positions along the shaft of the tentacle and at its extremity) are but contingencies, and therefore of no specific value, while they strongly evidence the existence of an axial support within.

The Actinophryans grouped together were not all of the same size, having varied a little in diameter below the $\frac{1}{450}$th part of an inch.

In fig. 4, which represents three separate Actinophryans sketched on a previous occasion (probably from fresh water), each was surrounded by a peripheral layer of vacuoles (which in the focal disk assumes the form of a chain only), but neither presented any trace of a nucleus in the interior. In *a* the vacuoles of this layer were uniformly small; in *b* they were uniformly large; and in *c* some were large and others small, while the tentacles of the latter only bore the drop-like masses of ectosarc just described. These Actinophryans were each about $\frac{1}{415}$th of an inch in diameter; they were sketched in January 1855, but there is no record of the kind of water, whether salt or fresh, from which they were obtained, although the following specimen (fig. 5), which was $\frac{1}{360}$th of an inch in diameter, and found in fresh water, is so identical in appearance with the last mentioned, that in all probability, as just stated, the whole came from fresh water. Fig. 5 is chiefly introduced to show that the ectosarc existed on the extremities of the tentacles in little spherical masses, as well as in ovoid ones along their shafts. In its interior some Diatoms were observed, which had been incepted for food, but no nucleus.

It was from observing the last mentioned Actinophryans and others like them, that I was led to make the following remarks in my "Notes on the Organization of the Infusoria" (Annals, vol. xviii. p. 129, 1856), and which I see have been quoted, but not exactly understood, in the last edition of Pritchard's 'Hist. of Infusoria,' p. 250, as follows:—"*Actinophrys Sol*, Ehr., is surrounded by a peripheral layer of vesicles, which, when fully dilated, appear to be all of the same size, to have the means of communicating with each other, and each, individually, to contract and discharge its contents externally, as occasion may require, although generally one only appears and disappears in the same place." From this I infer that I must have seen these "vesicles" or vacuoles burst and discharge themselves like the ordinary contracting vesicle.

Now, from Stein's having figured a chain of vacuoles round his *Actinophrys oculata,* and my figures of this species being, with this exception, identical with his—while the group fig. 3, although assuming the form of *A. Sol,* has been assumed to be but another form of *A. oculata,* and figs. 4 and 5, which I considered at the time they were sketched, and do now, as *A. Sol,* present a marginal chain of vacuoles similar to those in Stein's figure of *A. oculata,*—it seems to follow, that if all these Actinophryans are not different phases of the same species, the peripheral layer of vacuoles at least is of no specific value, any more than the presence or absence of the drop-like masses of sarcode about the tentacula. I have already quoted a passage from Claparède and Lachmann, in which they identify a species of *Actinophrys* which they found in the North Sea at once with *A. Sol* of the fresh, and Stein's *A. oculata* of the salt water.

With these end the descriptions and figures of all the Actinophryans which came under my notice, from time to time, at Bombay, that seem to me worth publishing. Let us now briefly turn our attention to those which I have found in England.

Plentiful as *A. Eichhornii* seems to be in England, I only met with two large specimens of it in Bombay; and when these were delineated for my last plate on the freshwater Rhizopoda, which was published in January 1864, I had not had an opportunity of studying this species in England.

Just afterwards, however (in December 1863), I accidentally obtained a large supply of it from a pool of fresh water in the neighbourhood of this place (Budleigh-Salterton), and took advantage of the occasion to make the observations and sketches which have enabled me to compile the fragment of the disk represented in Pl. XII. fig. 6. This, for comparison, has been drawn upon the same scale as the other Actinophryans, by which it will be observed that while the diameter of the latter is but half an inch, that of the former is 8 inches, or sixteen times as much, the real diameter of the smaller Actinophryans varying from $\frac{1}{600}$th to $\frac{1}{300}$th of an inch, and that of the largest specimens of *A. Eichhornii* being full $\frac{1}{30}$th of an inch. All have been drawn upon the scale of $\frac{1}{24}$th to $\frac{1}{5400}$th of an inch. Thus we are enabled more easily to appreciate their relative differences in point of size.

The fragment, by mistake, was at first drawn upon a radius of eight, instead of one of four inches; but as the error was only in the circle, the latter has been reduced to its proper size, which is all that is required. All the other detail, with the exception of the trifling discrepancies in the general outline of the fragment, is correct. To have cut the latter down to an exact segment of a four-inch radius would have destroyed the uniformity of the plate, while the reader can easily do this for himself, if necessary.

My object in giving such an enlarged view of a portion of *A. Eichhornii* has not been so much to compare its size or structure with that of the other Actinophryans as to bring into view certain spherical bodies which are situated and apparently developed in the intervacuolar sarcode, since it seems to me that these are as much "reproductive cells" of *Actinophrys* as those which I have figured and called attention to, from time to time, since 1856 up to the present day, in *Spongillæ, Amœbæ, Euglyphæ, Difflugiæ,* and, among the Foraminifera, in the living species *Operculina arabica,* and in fossil *Nummulites, Orbitoides,* &c.

So little attention appears to have been paid to these bodies in *Actinophrys Eichhornii,* that, although Kölliker is frequently and justly quoted as an authority on the structure of this species, in the last edition of Pritchard's 'Infusoria' no allusion is made to them beyond that at page 252, where this eminent physiologist is stated to have enumerated among the general contents of the body of *Actinophrys* "some separable nuclear cells;" but whether these be the ones in question or not, the context does not enable me to decide. Latterly, however, Dr. Wallich has undoubtedly described and figured them in his excellent representations of *A. Eichhornii* (Annals, vol. xi. p. 450, pl. 10. figs. 1 & 2 *n n*, 1863), and observes respecting them—"These multiple nuclei are distributed here and there through the protoplasm, each occupying a spherical cavity, which is completely filled up by the granular matter, and quite distinct in outward appearance from the polygonal soap-bubble-like mass of which the rest of the body is constituted." Any one at all conversant with the subject will, with this description, immediately recognize these bodies in my illustration; but whether they be derived from a subdivision of the nucleus, as Dr. Wallich seems to conjecture, or not, is a question to which I shall have to return presently.

With the large specimens were others of all sizes, down to $\frac{1}{400}$th part of an inch in diameter (fig. 7), and, I dare say, still smaller, if I had had more time to look for them; but all below a certain diameter failed to present the "reproductive cells" mentioned.

For a structural description I shall take one of the largest specimens, and, to avoid all tedious repetition of what has probably been better stated before, confine myself briefly to a summary of my own observations, chiefly with reference to a more particular account of the supposed "reproductive cells."

Actinophrys Eichhornii, Ehr., mihi.
(Pl. XII. fig. 6 : $\frac{1}{30}$th of an inch in diameter.)

Primary form globular, but slightly altering this according to circumstances. Length and size of tentacles also variable. Body vacuolar in structure; the interstices of the periphery are so much larger than those of the interior that they form a distinct layer over the latter; and this is so defined that the former may be viewed as the ectosarc (*a a a a*), and the internal portion as the endosarc (*c c c c*). "Granules," like those observed in *Amœbæ*, &c., are contained in the vacuoles (*e*), where they have a quivering motion exactly like that presented by similar bodies in the endoplasm of *Spirogyra*, in which this movement appears to be owing to the "irritability" of the plasma in which they are suspended. Indeed, to my knowledge, there are no two plasmata more alike in this respect than those of *Actinophrys* and *Spirogyra*; they are even more so than that of *Actinophrys* and that of the Desmideæ. The vacuoles, for the most part, collapse under the effect of iodine, leaving a granular plasma in their place. Tentacula composed of a granular plasma extended outwards from the inner portion or endosarc (*k k*) and receiving a more subtle covering from the ectosarc (*i i*); the former is well seen under the action of iodine, when the tentacula become wavy and contracted. Spaces between the interstices of the endosarc presenting spherical bodies imbedded in the intervacuolar sarcode, the larger ones about $\frac{1}{2000}$th of an inch in diameter (*d d d*), each filled with a thick plasma containing a group of granules in its centre, and the whole enclosed in a transparent spherical cell (*e*). Below this diameter they appear to vary to a mere point, and the granules and external cell not to be developed until they approach in size that above mentioned (*g g*). Sometimes there are two of the full size in one cell, as if the original one had undergone duplicative division (*h*). Iodine colours their fine contents of a light, and the granules of a deep amber-colour, which again, on the addition of a little dilute sulphuric acid, presents a pink tinge. In a specimen of this *Actinophrys* measuring $\frac{1}{30}$th of an inch in diameter, I calculated, after the vacuoles had been broken down by iodine, that there were between three and four hundred of the full-sized spherules or spherical bodies. Sometimes they are seen on their way through the ectosarc or cortical portion, and occasionally attached only to the margin by a thin film of the latter, spread over the spherule, and contracted to a delicate pedicel where it is in connexion with the parent. How far this may have been natural, or induced by pressure of the glass cover, I have not yet been able to decide. In one instance, after a matured spherule had been forced out of the parent, I observed that the transparent cell, which does not exceed it much in size, contained a fine delicate plasma, in the midst of which there was a single vacuole; and I could not help also seeing in this specimen the same elementary composition as that of an *Actinophrys*, viz. a thick endosarc with strongly marked granules, surrounded by a thin ectosarc in which there was a vacuole like a contracting vesicle. Whether that be the body, and these be the elements respectively which afterwards become developed into a young *Actinophrys*, is for future observation to determine. Crude food is incepted by *A. Eichhornii*, and contracting vesicles appear here and there; but I never could detect a nucleus in either the largest or the smallest specimens (fig. 7) that I have had under my observation.

It is true that, in the figure which I have given of *A. Eichhornii* found at Bombay, bodies are drawn which I conjectured to be respectively the nucleus and reproductive cells; but, as there is nothing so situated in the *A. Eichhornii* which I have been studying in England to identify with such bodies, the statement must be only taken for what it may prove worth hereafter. It is worthy of note, however, that Claparède says (*op. cit.* p. 452, foot-note), "En *A. Eichhornii* le nucléus est, au contraire, toujours facile à reconnaître." This certainly was not the case with any of the specimens of *A. Eichhornii*, small or great, that came under my notice; but then it might have been obscured by the vacuolation; for in another form of *Actinophrys*, which was also present, although not plentiful (viz. fig. 8), and even smaller than fig. 7, it was most evident in the endosarc, which was surrounded by a clear layer of ectosarc, bordered by a wrinkled margin or surface; but then there was no vacuolation. Probably if the vacuoles in the smaller forms of *A. Eichhornii* had been broken down, and the nucleus sought for in this way, it might have been observed; for I cannot help thinking that, at least when the spherical bodies are not present, there must be a nucleus.

Again, the absence of the nucleus, when the spherical bodies become numerous and fully developed, may be accounted for by its having passed into a brood of germ-cells, and its having thus become effete, as described and illustrated in *Difflugia* (Annals, vol. xiii. pl. 1. figs. 2, 3, 4, &c.).

When, then, we view an old *Actinophrys* with between three and four hundred of these spherules in her body, relatively analogous to, and absolutely of nearly the same size as those which I have already shown to exist in all the other Rhizopoda above mentioned, we can hardly doubt that they are of the same kind, and that they are an impregnated brood of reproductive cells, which, in like manner, will end, on becoming matured, in the death of the parent, as in the closely allied Myxogastres (Mycetozoa of A. de Bary), ex. gr. *Æthalium*, where the prolific mother lives but to become at last a dead receptacle for the future welfare of her numerous progeny.

The family of Saprolegnieæ are closely allied to that of the Myxogastres among the Fungi; and in the former Pringsheim has placed his *Pythium entophytum*, which, among other Algæ, infests the cells of *Spirogyra*, wherein I found its locomotive rhizopodous form to be so like *Actinophrys*, and, as before stated, the endoplasm of *Spirogyra* to be so like that of the latter, that I was led into the erroneous view, long since corrected, that the endoplasm of *Spirogyra* did thus actually become transformed into *Actinophrys*. This, then, will give the reader an idea of the position of *A. Eichhornii* with respect to these families.

With the general structure of *A. Eichhornii* I am not now particularly concerned. The spumaceous appearance which both the young (fig. 7) and old individuals (fig. 6) present seems to be due to vacuolation, and not to the presence of cells, according to the common acceptation of this term. Kölliker and most others who have studied this species are of the same opinion; but Prof. Clark, of Boston, has lately affirmed that these vacuoles are cells, because they have a cell-wall and alternate regularly with the tentacula (Annals, vol. xiv. p. 394). However, the presence of a wall around a sarcodal aqueous space, even with vibrating granules in it, does not, in the generally received meaning of the word, constitute a "cell." There should also be a nucleus, at one time or other at least, in most of such spaces, and they should at least also be of similar average size, form, &c., before they can be viewed as cells of an organized structure; while all this is reversed in the vacuoles of *A. Eichhornii*, which seem to me more to resemble, in accidental form and size, the fragmentary state of a veined or brecciated rock than those produced by the constant and immutable law which presides over the normal development of an organized cellular structure.

How this vacuolation is produced, and to what use it is subservient, has not been explained; but its accidental presence in the Infusoria and Algæ is not uncommon. Indeed it seems frequently to occur in the former from want of activity in the contracting vesicle—that is, after injury of the Infusorium or towards death. But in other instances, as in the first-formed cells in the germinating nucule of *Chara*, a similar vacuolation seems to precede and prepare the endoplasm for its rotatory function, and thus to be, as in *Actinophrys Eichhornii*, a normal condition (Annals, ser. 2. vol. xix. p. 13, "Development of Root-cell and Nucleus in *Chara*").

I do not mean to state that the "vacuoles" are "contracting vesicles," because, while they are stationary, the contracting vesicle, singly or in plurality, here and there is generally observed among them in full activity. But I am not so sure that they may not be a part of the system of which the contracting vesicle is the active organ. The occasional coalescence of the vacuoles, and their occurrence in the cortical part or ectosarc alone (figs. 4, 5) or when throughout the *Actinophrys* (as in figs. 6, 7), those of the ectosarc being differentiated by size, &c., from those of the endosarc, lead me to the inference that the spumaceous state of *A. Eichhornii* is due to a simple aqueous vacuolation, which forms part of the system of which the contracting vesicle, as just stated, is the chief agent, and therefore that its function probably is partly, if not chiefly, that of aëration, wherever it may occur as a normal adjunct. It is worthy of remark, while on this subject, that the young *Pythium entophytum*, on issuing from the parent capsule as a simple monociliated spherical body, apparently without contracting vesicle, sinks down almost immediately, and at the same moment presents the contracting vesicle, which, for a time, by the rapidity of its action and the size to which the inflation extends, seems to threaten destruction to the delicate little Rhizopod, until its function (which certainly looks like one of aëration) has had its full effect, when the contracting vesicle returns to its normal condition, the cilium disappears, and the little *Pythium* assumes the form, and progresses after the manner, of *Actinophrys*.

As regards the presence and absence of the contracting vesicle in the Rhizopoda, but more especially in the family which is now under consideration, I think it of no specific value whatever. It may be present singly or in more or less plurality, or absent altogether, according to circumstances; but in many Rhizopods, when present in its normal state, it seems to have a fixed position in the animalcule, as in *Euglypha*, *Arcella*, &c.

Again, the presence or absence of the nucleus in *Actinophrys* appears to be contingent. It is probably present in all the the younger forms; but as they advance towards the production of the new brood, it may disappear in the formation of germ-cells alone, or it may partly furnish germ-, and partly sperm-cells, in which case the spherical bodies in the endosarc of *A. Eichhornii* may also, perhaps, originate from the nucleus, as conjectured by Dr. Wallich (*l. c.*); but if the nucleus furnishes the germ-cells alone, then the others may be developed in the substance of the ectosarc, as their occurrence there, apparently in all stages of development, seems to imply.

Lastly, then, it may be asked, What are the specific distinctions among the Actinophryans? To which it must still be replied, Future observation must determine.

ACINETINA, Clap. & Lach.

I have observed several species of Acinetina in both the fresh and salt water of the island of Bombay, viz. *Podophrya fixa*, Ehr., *P. quadripartita*, Clap. & Lachm. (on *Epistylis*), *Sphærophyra*, C. & L., *Acineta tuberosa*, Ehr., and two or three others unpublished, of which I hope to give descriptions and delineations at some future time, my object being now more particularly to direct attention to the two commonest, and therefore those with which I am most conversant, not because they are new (for this they are not), or because they present differences which I think hitherto have not been noticed, but because they serve best to illustrate phenomena which have not been so pointedly exposed as they seem to me to deserve. These Acinetina are, no doubt, both forms of one species, viz. of *Podophrya fixa*; but while one (fig. 9) inhabits the fresh water of the pools, the other (fig. 10) is found in the salt water of the main drain of the island; and the differences between them are, that the former is a little larger and has a conical capsule, with few costæ (fig. 9 *e*), while the latter has a globular capsule, with many costæ (fig. 10 *d*). That such differences are constant, my sketches of each, made on several separate occasions, go to establish.

Having thus introduced these forms to the reader, I will now proceed to describe and illustrate the phenomena to which I have just now and often before alluded, but which, as above stated, I do not think have been so prominently brought to notice as they deserve, viz. the remarkable and almost unique example of an Infusorium being able to put forth and retract both vibratile cilia and capitate tentacula as they may be required, while this is apparently effected as much by extemporization as the stomachal spaces and digital prolongations of *Amœba*. These phenomena are witnessed not only when the *Podophrya* (figs. 9 & 10) undergoes duplicative division, but also during the changes which the young *Podophrya* undergoes from the time of its exit from the parent to its matured or tentaculated condition (fig. 11).

In the first instance, the *Podophrya* is seen to pass from its spherical to an elongated form, after which it presents a constriction in the middle, and the young half, becoming oblong, retracts its tentacula and throws out a wreath of cilia (fig. 9 *a*, *b*).

Separation then takes place, and the tentacula again begin to appear (*b*, *c*), when, in their turn, the cilia are retracted, the tentacula fully reproduced, and, finally, the young half (*d*) assumes the spherical form of the older one or parent (*a*).

In the second instance, the young *Acineta* (for my sketches of this happen to be taken from the young of *A. tuberosa*) leaves the parent with a wreath of cilia round its smaller extremity (fig. 11 *a*), in such a state of activity that it is difficult to follow it to its resting-place. This, however, soon takes place, and if successfully kept in view, the cilia will be found, on its having become stationary, to present a curved form, which has been occasioned by the centripetal force communicated to them by the young *Acineta* which they have been rotating in the opposite direction (*b*). The cilia then regain their straightness, and assume a radiated form, on which they begin to be retracted (*c*). After this, the tentacula appear (*d*); and finally the latter are fully extended, and the cilia withdrawn (*e*). This would be the end of the series in *Podophrya*; but *Acineta tuberosa* being a stalked form, its final development is not completed until this has been attained.

By some it might be said, as before stated, that the cilia and tentacula are as much extemporized as the stomachal spaces and digital prolongations of *Amœba*, while others would adhere to the opposite view. It is almost as difficult to conceive one as the other—that is, how vibratile cilia and tentacula, organs of totally different forms, and endowed with totally different functions and movements, can exist and be made to appear and disappear, with less complicated machinery than that which must necessarily accompany similar organs in animals much higher in the scale of development.

Perhaps there are no phenomena more remarkable among the Rhizopoda, in themselves or for the facts which they establish, than those just described, and none more easily followed and witnessed when the forms of Acinetina mentioned have been obtained for observation; for while some are continually undergoing duplicative division, the others are as continually sending forth a young one.

They are extremely restless animalcules in all respects, sometimes hardly being encapsuled before they burst forth again, and then become encapsuled a second time before the whole of their substance has left the first capsule (fig. 10 *e*). Both these forms of *Podophrya* also may be stalked (10 *c*).

For other observations on the Acinetina, containing views respecting their parasitic nature, &c., see my "Notes and Corrections" (Annals, vol. viii. p. 281, 1861).

COLLODICTYON, nov. gen.

Collodictyon triciliatum, n. sp. Pl. XII. fig. 12.

Pyriform, straight, or slightly bent upon itself, bifid at the small extremity, presenting at the larger one an indentation, from which spring three cilia. Structure transparent, cancellated, composed of globular cells, with a strongly marked greenish granule here and there in the triangular spaces between them. Locomotive, swimming by means of the cilia; subpolymorphic, flexible, yielding, capable of assuming a globular form (*f*) or one more or less modified by the body it may incept (*c, d, g*); enclosing crude material for nourishment in stomachal spaces, and ejecting the refuse, like *Amœba*. Provided with a nucleus and contracting vesicles.

Hab. Fresh water, chiefly among *Euglenæ* and Infusoria of that kind.

Size. Length $\frac{1}{771}$st of an inch.

Loc. Island of Bombay.

Obs. The plastic nature of this infusorium, and its mode of incepting food being like that of *Amœba* (for it does not appear to possess any oral aperture), induce me to think that it should be placed among the Rhizopoda. Still it seems to have some analogies with *Bodo*, Ehr. The curved form (*e*) approaches that of the colourless *Bodo* found in bunches, but, of course, is very much larger. If *Collodictyon* be a *Bodo*, then it is a large form of the latter, as *Anisonema* is a large form of the diplociliated Monad. Again, what *Astasia limpida*, Duj. (*Trachelius trichophorus*, Ehr.), is to *Euglena*, *Collodictyon* is to the cordiform, triciliated, *Euglena*-like Infusoria, of which probably *Polyselmis viridis*, Duj. (Hist. des Zooph. Infus. pl. 3. fig. 27) is one; that is, *Collodictyon* is the animal and *Polyselmis* the vegetable form of this Infusorium. Its generic name has been derived from its plasticity and delicate cellular structure, which gives it a reticular or cancellated appearance; and its specific designation from the presence of the three cilia. In voracity it is so greedy that it will frequently enclose part of a body which it is not large enough to enclose entirely (*g*); that is also like *Bodo*. The cellular spaces which pervade its body are uniform and globular, not variable in size and polygonal like those of *Actinophrys Eichhornii*; otherwise it so far resembles this Rhizopod. I have not inserted the contracting vesicles in the figures, because they are not to be found in my sketches, probably from their having no fixed position. The bifid extremity, although like the commencement of duplicative division, is, I think, a persistent character. Although this infusorium is very common in the island of Bombay, it is so restless, and its movements so rapid, that it is difficult to get at its real form.

Euglypha, Duj.

Euglypha spinosa, n. sp. Pl. XII. fig. 13.

Test. Oblong, rather wider in front than behind on the broad side, compressed, wedge-shaped, convex anteriorly and posteriorly, translucent, covered with subcircular plates, which, overlapping each other, present a more or less irregularly cancellated appearance (*b*). Aperture rimous, extending throughout the anterior border. Ventral portion more or less inflated. Sides and posterior extremity narrow, terminating in an angular ridge, which behind, and for two-thirds of its length laterally, supports a row of moveable spines based on fixed tubercles, like those of *Cidaris* (*c c c c*). Spines clavate, pointed at their free ends (*c'*).

Animal. Sarcode containing fragments of incepted food and granules anteriorly (*f*), behind which it is charged with granules alone (*g*); and posterior to all is the nucleus (*h*). Pseudopodia and contracting vesicles not seen, but probably the same as in *Euglypha alveolata*, &c.

Hab. Heath-bog water.

Size. Length $\frac{1}{171}$st, breadth $\frac{1}{285}$th of an inch.

Loc. Budleigh-Salterton, South Devon.

Obs. I have only seen two or three specimens of this Rhizopod; and, it being winter, the animal part in all was passive. Thus the aperture was in all probability much more compressed than during active life. The sarcode was retracted, and there was a kind of diaphragm about halfway between it and the anterior extremity. The most remarkable feature about it, next to its wedge-like shape, is the presence of spines, which, in some instances, lying across each other while the tubercles remained fixed, showed that they were moveable, like those of the Echinodermata. Widely separated, however, as the latter are from the Rhizopoda, still they have many points of resemblance in their living state, and are frequently and almost exclusively associated in a fossil one.

Euglypha globosa, n. sp. Pl. XII. fig. 14.

Test. Globular, with a short compressed wedge-shaped neck and narrow aperture, which can be closed by the animal (*a*). Globular portion translucent, covered with uniformly circular scales, which are so arranged as to slightly overlap each other hexagonally, and thus present a cancellated structure of the most regular appearance. Neck studded with minute points, perhaps minute scales. Supernumerary scales within the test (*e e*).

Animal. The same as that just described, and as in *Euglypha* generally. Pseudopodia and contracting vesicles not seen, but may also be inferred to be the same as in *Euglypha.*

Hab. Heath-bog water.

Size. Body $\frac{1}{545}$th of an inch in diameter; neck $\frac{1}{1200}$th broad.

Loc. Budleigh-Salterton, South Devon.

Obs. This species is very plentiful in its habitat, but very small. Its features are very constant, and its size also; but I have never been able to see its pseudopodia, although I have watched it long and repeatedly. The presence of supernumerary scales in it is exactly like that which I have already figured in *Euglypha alveolata* and in *E. pleurostoma* (Dujardin's *Trinema*). Its relative size, as well as that of *E. spinosa,* in proportion to the other testaceous Rhizopoda which I have figured (*l. c.*), will be observed in dotted outlines (figs. 13 *g* and 14 *d*).

EXPLANATION OF PLATE XII.

N.B.—Figures 1 to 10, inclusive, are drawn upon the scale of $\frac{1}{24}$th to $\frac{1}{5400}$th of an inch, and fig. 11 upon a little larger scale. Figure 12 is upon the scale of $\frac{1}{12}$th to $\frac{1}{5400}$th of an inch, and fig. 13 upon that of $\frac{1}{24}$th to $\frac{1}{6000}$th of an inch, while fig. 14 is upon the scale of $\frac{1}{6}$th to $\frac{1}{6000}$th of an inch. Figures 13 *d* and 14 *g* are outlines of figs. 13 and 14 respectively, on the scale of $\frac{1}{6}$th to $\frac{1}{830}$th of an inch, for comparison with those of the testaceous Rhizopoda in plate 1, vol. xiii. of the 'Annals,' which are on the same scale; and fig. 12 *h, i* would be the lengths respectively of fig. 12, if drawn on the scales first and last mentioned in this paragraph.

The Actinophryina and Acinetina should be viewed not as discoidal, but globular bodies, with tentacles proceeding from their surfaces generally, and therefore the marginal lines of vacuoles only as an indication of the peripheral or ectosarcal layer which exists all over them respectively.

Fig. 1. *Actinophrys oculata,* Stein. Group of four individuals, the largest $\frac{1}{450}$th of an inch in diameter, each presenting a nucleus and nucleolus, and all bearing drops of sarcode on their tentacles, but the latter only represented in *a*; *b*, uniting sarcode; *c*, vacuoles in the latter, containing food; *d*, vacuoles containing each a subrotund, colourless, amylaceous (?) body.

Fig. 2. The same: outline only of a group of nine individuals, in every respect the same as those of fig. 8, but with smooth tentacles: *a*, circles representing the Actinophryans, $\frac{1}{540}$th of an inch in diameter; *b*, uniting sarcode; *c c*, vacuoles in the latter, containing respectively the remains of a rotatory animalcule; *d*, as before.

Fig. 3. The same (?), in the form of *Actinophrys Sol* (?); nine individuals in the group, closely approximated, and varying in size, the largest (*a*) being $\frac{1}{450}$th of an inch in diameter; *b*, two or three in zygosis; uniting sarcode not seen; *c*, vacuoles in the latter, containing food; *d*, as before. All the above from salt water, in India.

Fig. 4. *Actinophrys Sol* (?); three separate individuals, each $\frac{1}{415}$th of an inch in diameter, each bearing tentacles, each presenting an ectosarcal layer of vacuoles, but no nucleus: *a*, specimen with vacuoles uniformly small; *b*, ditto with large; *c*, ditto with both small and large, and the tentacles on this bearing drops of sarcode. India, fresh water (?).

Fig. 5. The same (?) As the foregoing, but with the tentacles bearing little spherical bulbs of sarcode at their ends as well as drops along their course, the interior containing Diatoms. India, fresh water.

Fig. 6. *A. Eichhornii*, Ehr. Fragment of an individual, $\frac{1}{30}$th of an inch in diameter, magnified upon the same scale as the foregoing: *a a a a*, peripheral or ectosarcal layer of vacuoles, the larger ones $\frac{1}{300}$th of an inch in diameter; *b b b b*, dotted lines indicating respectively the circumference of the figure and the width of the ectosarcal layer; *c c c c*, vacuolation of the endosarc, in which the interstices are much smaller than those of the ectosarc; *d d d d*, spherical bodies or reproductive cells, about $\frac{1}{2000}$th of an inch in diameter, as they appear in the intervals between the vacuoles of the endosarc; *e*, more magnified view, showing that these bodies are, in their advanced stage, respectively enclosed within a transparent spherical cell or capsule, and that the former presents a group of granules in the centre of its plasmic contents; (here we seem to have the first elements of an *Actinophrys*, viz. an ectosarc, endosarc, and "granules," which, in one specimen that I observed, still nearer approached it by the transparent cell presenting a fine protoplasm without granules, and a vacuole); *f*, the same before the formation of the cell; *g*, three of the same, of different sizes, before the granules appear; *h*, two of the same (on the scale of those seen in the "fragment") enclosed in one cell; *i i*, tentacles covered with ectosarc; *k k*, axial portion extended from the endosarc; *l*, vibratile granules of the cells. England, fresh water.

Fig. 7. The same; specimen of individuals $\frac{1}{400}$th of an inch in diameter accompanying the larger ones just mentioned, but in which neither nucleus nor reproductive bodies were observed. England, fresh water.

Fig. 8. *Actinophrys* ——? specimen $\frac{1}{644}$th of an inch in diameter; ectosarc surrounded by a wrinkled surface, as in *A. oculata*, and differentiated from the granular and more clouded endosarc by a more translucent and finer material; endosarc presenting a well-defined nucleus. Found with the foregoing, in fresh water.

Fig. 9. *Podophrya fixa*, Ehr.: *a*, parent half, $\frac{1}{600}$th of an inch in diameter, undergoing duplicative division, tentaculated, but without cilia; *b*, daughter half, elongated and becoming separate, presenting vibratile cilia and a few short tentacles; *c*, *d*, another instance, in which the separated and elongated portion, *c*, with vibratile cilia and a few short tentacles, has passed into the spherical form, *d*, without vibratile cilia and with long tentacles; *e*, conical capsule of this variety, presenting fourteen costæ. India, fresh water.

Fig. 10. The same (?): *a*, parent half, $\frac{1}{771}$st of an inch in diameter; *b*, daughter half nearly separated, presenting vibratile cilia, &c.; *c*, stalked condition; *d*, spherical capsule of this variety, presenting eighteen costæ; *e*, instance where the *Podophrya* has nearly left its first capsule, and has formed another around itself on the top of the original one. India, salt water. In almost all those here figured, the contracting vesicle and the nucleus, which appeared to be globular, were observed.

Fig. 11. *Acineta tuberosa*, Ehr., embryo of, showing, in series, the changes which it undergoes from the active state on its exit from the parent, to its passive, tentaculated, and spherical form: *a*, active state on issuing from the parent, when it is provided with a circlet of vibratile cilia; *b*, its globular form, assumed on becoming comparatively passive and stationary, $\frac{1}{1350}$th of an inch in diameter, the cilia passive and curved from the centripetal force occasioned by the rotatory motion which they originally communicated to the young *Acineta* in its active state; *c*, the cilia regaining their straightness, and becoming shorter; *d*, the cilia disappearing, and short tentacles projected; *e*, the cilia gone and the tentacles increased in number and elongated. India, fresh water.

Fig. 12. *Collodictyon triciliatum*, n. sp. Length $\frac{1}{771}$st of an inch: *a*, posterior (?) view, showing bifid extremity, three cilia, central line and nucleus, cellular structure and granules; *b*, lateral view; *c*, presenting a digestive space containing an incepted *Protococcus* in the 8-cell division; *d*, ditto containing a *Crumenula texta* nearly as large as itself; *e*, outline of another but common form of this Rhizopod; *f*, ditto of a globular form; *g*, one enclosing the central portion of a filament of *Oscillatoria*, while the two ends are outside the animalcule; *h*, length on the same scale as the Actinophryans; *i*, length on the same scale as that of the testaceous Rhizopoda, figs. 13 *d* and 14 *g*. India, fresh water.

Fig. 13. *Euglypha spinosa*, n. sp.; specimen $\frac{1}{171}$st of an inch long and $\frac{1}{285}$th of an inch broad; animal retracted within a diaphragm, and passive: *a*, view of broad side of test; *a'*, ditto of narrow side, or lateral view; *b*, scales on test; *c c c c*, moveable spines on fixed tubercles; *c'*, more magnified view of the spine; *d*, dotted outline of test on a scale of $\frac{1}{6}$th to $\frac{1}{830}$th of an inch, for comparison with other figures of testaceous Rhizopoda, *l. c.*; *e*, diaphragm; *f*, portion of sarcode containing fragments of food; *g*, ditto charged with granules; *h*, nucleus. England, fresh water.

Fig. 14. *Euglypha globosa*, n. sp.; specimens $\frac{1}{545}$th of an inch in diameter: *a*, empty test covered with circular scales hexagonally arranged, also showing the broad side of the neck and open aperture; *b*, ditto, showing the narrow side (or lateral view) of the neck and closed aperture, also *c c*, supernumerary scales; *d*, test containing the animal, passive, with closed aperture; *e*, sarcode containing fragments of food; *f*, nucleus in posterior and granular portion of sarcode. England, fresh water.

XXXIII.—*Contribution towards the Knowledge of the* Rhynchoprion penetrans. By Hermann Karsten*.

[Plates VIII. & IX.]

[In this paper Professor Karsten remarks upon the imperfect knowledge which we still possess of this curious parasite—the Nigua, Chigoe, Jigger, or Sand-Flea of tropical America,—notwithstanding that the first European visitors to the New World

* Translated from a separate copy of the paper in the 'Bulletin' of the Society of Naturalists of Moscow, communicated by the author.